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ABSTRACT

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Individualized Group Computer-Assisted Instruction

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Abstract

The study investigated the learning and attitudes of individuals in an individualized computer-assisted instruction (CAI) setting using a specially designed group CAI program to permit the entry and evaluation of responses from each group member.

Results suggest that individuals in groups learn as well as individuals working alone with conventional CAI, but take somewhat longer to complete each program. In spite of this, large cost savings resulted since the group took significantly less time than had each individual worked alone. Attitudes towards CAI were found to be unaffected by exposure to this type of CAI treatment.

Individualized Group Computer-Assisted Instruction

The potential for individualizing instruction by taking into account individual differences among students in intelligence, personality, motivational levels and other factors, has always been a central feature of computer-assisted instruction (CAI). At the same time, CAI has often been criticized for forcing students to work in isolation. In defence, some proponents of CAI have suggested that perhaps two or more people might interact with CAI materials at a single terminal (Carpenter, 1970; Cartwright, 1973). Such an arrangement might bring about substantial cost reduction by reducing the number of lesson executions to teach a given number of students. In fact, most studies completed in this area usually report that students learn equally well from CAI whether taught individually, in pairs, or in groups of three or four (Cartwright, 1973; Okey & Majer, 1975), and cost reductions as high as seventy-five percent have been cited. On a more humanistic level, the social isolation of a single student working alone at a computer terminal is eliminated and students may interact with each other as well as with the machine.

Past studies however, have centered on small groups of students interacting with CAI programs originally designed for individual use. The method most often employed was to encourage group discussion, to arrive at some form of concensus, and then to type in a single, collective, group

response for evaluation by the computer. Feedback from the computer was given in relation to this group response. This may be called "concensus group CAI." Although some attempts have been made to explain how students learn through collective group feedback even though they may not have made an overt response or even agreed with the group response (Cartwright, 1976), previous work in other areas has demonstrated the importance of overt responding under various conditions (Holland, 1960; Goldbeck, Campbell & Llewellyn, 1960; Stolurow & Walker, 1962; Tobias, 1973). It would seem reasonable to suggest that individual learning in groups might be further enhanced if special CAI programs could be designed for groups which would allow each individual to enter his own response, have it evaluated, and receive his own individual feedback. This may be called "individualized group CAI."

Method

To test whether CAI programs designed specially for groups would improve individual performance, three treatments were established, in which randomly assigned subjects were required to take a series of three CAI lessons in introductory psychology. The lessons were coded in a CAI author language known as CAN VI (Cartwright & Tessler, 1975) and were administered by an IBM 370/158 computer on ten Teletype terminals. All of the lessons had been used in previous studies (Roid, 1970, 1971; Cartwright, 1973). Control group 1 completed the three CAI lessons individually

as in conventional CAI. Control group 2 consisted of small ad hoc treatment groups of three students who were asked to discuss the CAI material, to arrive at a concensus, and to enter a single group response. The experimental group also contained ad hoc groups of three students who were asked to discuss the material without the requirement of arriving at a concensus. Instead, each student was asked to enter his own response on the terminal.

The 28 male and 28 female subjects were drawn from three sections of an introductory class in educational psychology at McGill University. All had a Bachelor's degree, limited background in psychology, no experience with CAI, and were enrolled in a one year teacher training course. Their mean age was 21.8 years.

For the purposes of the experiment, a special version of the CAN VI language was developed in order that programs originally written for individuals could be used in the experimental treatment with little modification. At each point in the program where a student response was expected, this special version of the language accepted three responses, evaluated each of the three responses, and issued three separate feedback statements based on those responses to each of the three students. It kept three sets of student performance records, one for each student, and called each student by name throughout the program.

Each of the lessons comprised about 35 "frames" and were based on a textbook by Hebb (1966). The experimental group was presented with some material which they were asked

to discuss. After discussion, each of the three subjects typed in his own response. When all three responses had been entered, the computer issued feedback to each of the three students. An example of these feedback statements might be:

No, Mary, we were looking for a nine letter word that refers to cells that receive information. That is, receptors.

Harry, you are also wrong.

Dick, you are correct. Receptors.

Each of the groups took the three lessons within one week. Five days after completion of the third lesson, subjects individually took a 30 item pencil-and-paper attitude test (a version of the Brown, 1966 scale) and an unannounced criterion test consisting of 30 multiple-choice items based on the three lessons.

Results

During the course of the study, eleven subjects did not complete all the requirements that would permit the inclusion of their data in the study. Interestingly, of these eleven, nine were in the conventional CAI group, control group 1. While this was the least important of the two control groups, it was decided to attempt to replace these subjects even though this might upset the strict randomization of the experiment. A total of 15 students (9 females and 6 males, mean age 20.6 years, Bachelor of Education students with limited background in psychology)

were added to control group 1. Mean criterion test scores are shown in table 1.

Insert table 1 about here

Analysis of variance results for the three treatments on criterion test scores showed no significant differences in mean individual learning scores or variances.

The number of correct, incorrect, and unanticipated responses is shown in table 2.

Insert table 2 about here

Analyses of the mean number of correct, incorrect, and unanticipated responses indicated significant differences among means for the three treatments ($F(2,57)=18.31$, $p<.001$; $F(2,57)=13.14$, $p<.001$; $F(2,57)=26.21$, $p<.001$). A Scheffé multiple comparison of means test indicated that the group which responded by concensus made significantly more correct responses than either the individuals working alone or the experimental group ($p<.001$). In addition, it was found that individuals working alone made significantly more errors than either of the other two treatments, and a similar trend was found for unanticipated responses.

Table 3 presents the means and variances of attitude test scores for the three treatment groups.

Insert table 3 about here

Analysis of variance results indicated a significant difference among the treatments. Those who worked in the conventional CAI group (control group 1) had significantly higher positive attitudes towards CAI in general. Since this was the group to which replacement subjects had been added, it was decided to repeat the analysis omitting the fifteen replacement subjects and using only the five original remaining members. The analysis showed no significant differences in attitude among the treatments ($F(2,42)=0.16$, $p=.0856$).

Means and standard deviations for elapsed lesson time are presented in table 4.

Insert table 4 about here

It had been predicted that the experimental group would take slightly longer than either of the other two treatments, but that this time would be considerably less than the total time for three students working under conventional conditions of individual CAI. Analyses of variance for each of the three lessons on elapsed time showed significant differences among the treatments for each of the three lessons ($F(2,57)=37,76$, $p<.001$; $F(2,57)=56.77$, $p<.001$; $F(2,57)=33.40$, $p<.001$). A Scheffé multiple comparison of means test showed significant differences

among all the three treatment means. For each lesson, the conventional CAI treatment group took significantly less time and the experimental group took significantly more time, than each of the other two treatments.

Discussion

The lack of significant differences in criterion learning scores among the treatments supports previous findings (Cartwright, 1973; Okey & Majer, 1975), and suggests that students who work in groups with individualized group CAI learn as well as those who work with individual CAI or concensus group CAI. The results also suggest that groups which respond by concensus tend to converge on the correct answer more fequently than do subjects who work alone or who work with individualized group CAI. Subjects in each experimental group were given as much opportunity to discuss the material as subjects in each concensus group. Nevertheless, subjects in the small experimental groups did not make as many correct responses as their counterparts in the concensus groups. It might be interesting to know if the same degree of discussion actually took place in both treatments, or if the removal of the requirement for concensus in the experimental treament reduced the amount of discussion.

The finding that individuals working alone made significantly more errors than individuals working together in teams confirms those of a previous study (Cartwright, 1973).

With respect to the differences in attitude scores among the three treatments, it is possible that this may have been brought about by the inclusion of keen Bachelor of Education students as replacements for the dropouts from control group 1. At least one other study has suggested that different attitudes toward CAI may be held by students in different educational programs (Cartwright & Derevensky, 1976). We noted earlier with interest that it was the conventional CAI group which experienced most of the dropouts. The fact that the dropout rate was not nearly as dramatic in either of the other two groups suggests the existence of some form of peer pressure, brought about by group structure, which tended to hold the small groups together. Naturally, the results must be interpreted cautiously since the replacement of subjects violates the strict randomization of the experiment. Still, when only the remaining original subjects were used, the difference in mean attitude scores disappeared. Since further analysis indicated that attitudes towards CAI were unrelated to performance in this study, it is quite likely that the original difference was brought about by an initially higher attitude toward CAI score among the replacement subjects.

Although the experimental group took significantly longer in terms of elapsed time to complete the lessons than either of the control groups, the total time was still significantly less than the total amount of time required for three subjects working alone as in conventional CAI.

Further research is recommended in the area of long-term retention and overt responding under these kinds of group CAI conditions. More work is needed to determine if special kinds of programs can be developed to provide remediation to individuals within the group setting.

In summary, a number of advantages can be claimed for individualized group CAI. These include:

1. non-isolation of the student.
2. no decrease in learning performance
3. significant cost reduction in terms of computer time and utilization.
4. provision of individual response, and individual feedback.
5. the collection of individual student records in the group setting.
6. elimination of problems of non-participation inherent in other forms of group CAI.

Note

This study is a revised summary of the work by Cohen (1975).

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TABLE 1

Means and Variances of Individual Learning Scores

For the Three Treatment Groups

Treatment Group	N	Mean	Variance
1. control group 1	20	16.85	14.56
2. control group 2	18	18.44	13.44
3. experimental group	22	16.50	20.55
All subjects	60	17.20	16.29

TABLE 2

Means and Standard Deviations of Average Number of Group Responses for the Three Lessons Combined

Type of Response		Control Group 1	Control Group 2	Experimental Group
Correct	mean	71.35	80.78	70.41
	s.d.	6.51	1.16	7.29
Incorrect	mean	9.65	3.50	6.27
	s.d.	5.03	2.04	3.33
Unanticipated	mean	20.85	11.33	10.18
	s.d.	6.52	3.48	4.86

TABLE 3

Means and Variances of Attitude Test Scores

For the Three Treatment Groups

Treatment Group	N	Mean	Variance
1. control group 1	20	101.70	192.64
2. control group 2	18	89.39	210.96
3. experimental group	22	89.50	286.17
All subjects	60	93.53	247.98

TABLE 4

Means and Standard Deviations of Elapsed Time

for the Three Treatments

CAI Lesson		Control Group 1	Control Group 2	Experimental Group
lesson 1	mean	35.90*	27.96	43.13
	s.d.	7.95	2.83	4.28
lesson 2	mean	36.03	26.93	44.29
	s.d.	5.66	3.52	3.56
Lesson 3	mean	39.66	33.83	48.11
	s.d.	8.10	3.46	3.90
N		20	18	22

* time in minutes